EPISODE SIXTY-TWO OF "ARMED WITH SCIENCE: RESEARCH APPLICATIONS FOR THE MODERN MILITARY," A DEPARTMENT OF DEFENSE WEBCAST HOST: DR. JOHN OHAB GUEST: DR. PETER JUTRO, DEPUTY DIRECTOR FOR SCIENCE AND POLICY, ENVIRONMENTAL PROTECTION AGENCY'S NATIONAL HOMELAND SECURITY RESEARCH CENTER DATE: WEDNESDAY, APRIL 7, 2010

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ANNOUNCER: "Armed with Science: Research and Applications for the Modern Military" is a weekly webcast that discusses cutting-edge science and technology, and how they apply to military operations. Each week we will interview scientists, administrators and operators to educate and inform our listeners about the importance of science and technology to the modern military.

DR. OHAB: Good afternoon and welcome to episode number 62 of the "Armed with Science" podcast. Today is Wednesday, April 7, 2010. I am Dr. John Ohab at the Office of the Assistant Secretary of Defense for Public Affairs.

You know, one of the things I really love about this podcast, in addition to talking with some really amazing men and women, is the opportunity to highlight how science and technology is at the center of so many collaborative efforts between federal agencies. Previous shows have explored NASA, the National Institutes of Health, the Department of Veterans Affairs, and others. Today we're going to explore scientific collaborations between the Department of Defense and the U.S. Environmental Protection Agency, or the EPA.

We're joined by Dr. Peter Jutro. He's the deputy director for science and policy at EPA's National Homeland Security Research Center. Dr. Jutro will discuss how the EPA is working with the Defense Department on various research and technology endeavors in the area of homeland security. These include efforts to protect drinking water and improving methods for decontaminating buildings and other outdoor areas after chemical, biological or radiological attacks.

Dr. Jutro, it is really a pleasure to have you here on the program. How are you today?

DR. JUTRO: Thanks, John, very well. And I really appreciate the invitation. I'm looking forward to this.

DR. OHAB: Well, thank you so much for being here.

Before we get into how the EPA is collaborating with the Defense Department, can you give our audience just a little primer on the EPA? Specifically, what are the roles and responsibilities in homeland security research?

DR. JUTRO: Well, that's a good question, and you phrased it unusually politely. Usually when I get up and introduce myself as being from EPA and talk about homeland security, I see the eyebrows go up and people say, "You didn't really mean that did you? You're from DHS or you're from the Defense Department." And then when I say, no, I really am from EPA, they'll say, "That makes no sense. Why does EPA have anything to do with terrorism or with national security?"

Well, if you think about it, it actually does make sense and it's kind of an extension of EPA's historic mission. EPA has two homeland security responsibilities that were given to us by Congress and also by presidential decision directives over the last couple of administrations. We are the lead federal sector for protecting the nation's drinking water in the same way, say, that the Department of Agriculture is responsible for the ag sector, or the Department of Energy is responsible for the electric sector, or Treasury is responsible for the banking sector -- logical connections. In the same logical way, we're responsible for the water sector. And if a homeland security incident occurs -- whether it's chemical, or biological, or radiological or nuclear, or even an explosion that results in contamination, EPA has the lead federal responsibility to handle the decontamination.

So what my center does is to do the research and provide the scientific information that practitioners and policymakers need to fulfill those responsibilities. And our researchers work closely with people in the Defense Department, and DHS, Department of Health and Human Services, and we do all sorts of things, from developing detection tools, to establishing procedures, to contain contamination, to measure risks, to support the on-scene coordinators and other responders. We try to develop safe disposal methods and evaluate new and promising cleanup technologies. Our homeland security researchers work with EPA's policy officials, with emergency responders, and of course, by extension, with the states, and the local public, and private personnel in carrying out those two missions.

And I should also say -- you asked questions about the broader EPA, and I'm only going to talk about a little of it, but we coordinate our research with other people in EPA that aren't in the research office. For example, under FIFRA, which you may have heard of -- it has the wonderful long title of the "Federal Insecticide, Fungicide and Rodenticide Act," but under that Act, EPA has to approve the use of any antimicrobial that might be used for decontamination. So the rules for pesticides you use in your home are essentially the same ones that we would use to decontaminate anthrax contamination, and that we did use in the Hart Senate Office Building.

So after a security incident has occurred, EPA evaluates the safety and the efficacy of products that are used in the environmental cleanup before authorizing their use.

DR. OHAB: So how do the EPA and the Defense Department mutually benefit from a research partnership in the homeland security area?

DR. JUTRO: That's an excellent question. And I think before I specifically get at the mutual benefits, I think it's kind of important to understand the missions of the two agencies -- where they're similar and where they're different.

First of all, I think it should be clear that EPA and DOD have common goals regarding response and recovery, but they have different missions. Obviously, on the battlefield, if an attack takes place and you asked the commandant or the commander what his immediate priority is, he's going to say that it's to maintain the mission.

But in addition to that -- and I'll get to EPA's mission in a moment, I think it's important to note that we're also dealing with two very, very different populations:

The military warfighters -- they're mostly young, strong, healthy men and women who've been selected for stressful duty, and they have the obligation to maintain the capability that the commander I was talking about before is talking about, even if they have to put on cumbersome MOT (sp) gear, or the protective gear that the military wears when it's exposed to something that might otherwise threaten them. But the general population can't be expected to do that. It includes people from children to the elderly; it includes the ill and the healthy, the susceptible, the resilient.

All of these people have a broad spectrum of health concerns, most of which you're not going to encounter in the military population.

Also, on the battlefield casualties, unfortunately, are understood to be a part of warfare. But on the civilian side this is not the case, and EPA's mission is to protect the public health and the environment. The direct parallel might be DOD's responsibility to protect the lives of DOD personnel on a military base that might be attacked.

But, beyond that historical, conventional mission, you know the DOD has often been called in to help the civilians in times of emergencies. In fact, now it's even got a relatively new set of entitles -- the National Guard, what are called the "WMD" or Weapons of Mass Destruction "Civil Support Teams," the CSTs, and their job is to help domestic emergency responders help our civilian population.

So in that context we're both not only part of a team whose mission is focused on preventing death and relieving suffering, but we at EPA have to remember our historic mission, which is ensuring the health of the population, the long-term sustainability of ecosystems, and, of

course, by extension, we all try and help society and the economy return to normalcy as quickly as possible.

Now, EPA's statutes direct us to protect all populations. As I said before, that includes children, and the elderly and those who, for any number of other reasons, might be more vulnerable to the detrimental effects of toxic chemical agents or biological agents. We also know that there's a big difference in risk tolerance between most of our civilian citizens and our military, and dealing with risk expectations becomes a big part of the equation for us in the civilian world, and clearly for EPA.

So having said all of this, let me get to your question. EPA benefits from the Defense Department's research in several areas. For example, before 9/11, EPA had worked with historical contamination incidents involving old military efforts in this one example -- for instance, where chemical warfare agents left over from the First World War up in Spring Valley in Washington, D.C., where work had been done back at the beginning of the 20th century on mustard and lewisite.

But now we find that we're being exposed to the potential of a problem with many, many more agents, things that have subsequently been developed as chemical warfare agents. And those are the ones in which we don't have a lot of historical experience, so we've had to work collaboratively with DOD. One example is we had to use DOD to get ultra-dilute chemical warfare agents that our civilian labs need in order to calibrate their testing equipment, and also to devise standards for testing. This is new territory for us.

We're also working on protocols and technologies for identifying biological agents with DOD. We're working with DTRA, the Defense Threat Reduction Agency, on liquids sporicides for cleaning up anthrax contamination. We're working closely with ECBC, the Edgewood Chemical, Biological Center, to explore ways to decontaminate anthrax and ricin. In fact, just this spring -- just over the last few days, in fact, we've been working with the DOD chemical and biological defense researchers, as well as the S&T division of the Department of Homeland Security, on a tri-agency technology coordination agreement, so that we can collaborate; learn what each other are doing; and try and do our best to leverage each other's research in these areas and related ones.

And finally, we've interacted with OSD -- with a sister part of your office, on issues relating to risk communication and the science of understanding what the drivers of public expectations are. If you're in the military, you know how to respond to an order or an instruction. We really are only beginning to learn how the public is going to respond to the information that we provide to them, or that we'd like to provide to them. And we may want to -- we may want to tweak our message so that we can get the compliance, and the concern that we want, or the reassurance that we want from the public.

DR. OHAB: Now, earlier you mentioned water security and decontamination as areas of emphasis for EPA, so I was hoping you could focus on those for just a moment. How does EPA's research and

development program provide the methodologies that support the agency's responsibility in water security and decontamination?

DR. JUTRO: Okay. Well, as a research organization, John, we have two primary sets of customers: Probably our major R&D customer is within EPA. It's the Water Security Division, which is within EPA's Office of Water, which is a sister component of EPA's Office of Research and Development. We're not as complicated as DOD, but we are complicated -- that is another office. Also, we work with the public and private utilities that own and operate drinking water supply facilities.

Now, historically in the United States, the largest U.S. water utilities have been owned and operated by local governments -- some cities like Baltimore, or New York or San Francisco. They have water departments within their city and county governments. Smaller water utilities have many different kinds of ownership. And, as an analogy, on a military base the federal government owns the system. But that's fairly rare, and in that particular case, the base or the post commander, you can think of him or her in the same way as you might think of the mayor of a city or the head of a public works department. The thing that's important is the drinking water suppliers are almost everywhere in the United States and, John, these numbers are absolutely staggering. There are more than 50,000 community water systems in the United States that serve about 96 percent of our population, almost 300 million people.

Now, in our normal role, through EPA, the federal government imposes standards or goals on these water supplies so that they provide a particular level of water quality. The 50 states then have the responsible to implement these goals or standards with their own regulations. And the water suppliers have to comply with these. Their job is to maintain the water quality. So they'll have to do monitoring; they may have to do water protection; they may have to do treatment.

And protecting critical infrastructure is also expensive. It is, as they say, "capital intensive." Most of the larger systems are publicly owned and financed, but they're fiscally constrained. They're constrained by the rates that they can charge their customers, and these rates are often set by utility commissions. And frankly, it's tough to finance and implement any new drinking water standards, especially homeland security protections, because people do their mental calculations and these strike them as rare events, and they're added to the expenses that they have to incur to maintain, and repair and possibly replace an aging infrastructure.

Pretty much throughout the United States water systems are struggling to maintain service delivery, because doing anything to improve the system generally means either issuing bonds; and to issue bonds you probably have to raise taxes in order to pay them off. So although a lot of technology to work in these areas actually exists, many systems, in reality, are faced with a choice between fixing broken water mains or adding protection.

On top of this, many systems have started switching their disinfectants in order to reduce their vulnerability or to increase

public safety. It used to be that everyone used chlorine gas in order to disinfect water. But now, with the possibility of accidents, and leaks, and actually are seeing the use of chlorine gas as a terrorist weapon in Iraq, a lot of systems are changing from the direct use of gas on-site to the use of water-soluble disinfectants. So that's a big change that has economic consequences.

Now, much of the work that we do at EPA and in the National Homeland Security Research Center, in the water infrastructure protection area, would be used to evaluate vulnerabilities to physical or contamination -- physical attack or intentional contamination. So a contamination attack may involve someone, say, injecting a toxic substance -- it might be a chemical warfare agent, it might be a biological warfare agent, somewhere into a water supply system. Now, a physical attack, obviously, could threaten a key piece of infrastructure. But the key is that all of this expands on EPA's historic mission where we've been in the business of setting health- based drinking water quality standards for decades under the Safe Drinking Water Act.

DR. OHAB: We actually, last July, had the Pentagon Force Protection Agency on the program, and some of their scientists were discussing their work in preparing for biological or chemical attacks on the Pentagon itself.

From a research perspective, what are some of the challenges to cleaning up after a major biological or chemical attack?

DR. JUTRO: Oh, it's a huge problem, John. And I should add that we actually worked with the Pentagon Force Protection Agency in several of their exercises. We worked with them in the design and our operators worked with them in the execution, so we know the particular challenges that they face.

Our scientists actually have made a lot of progress. It's really enormous progress, but there are still a lot of challenges, in terms of cleanup, that are out there. The things we have to do, in a sense, is straightforward, but the solutions aren't:

We have to understand, in exquisite detail, the toxicity, say, of a chemical agent that we might be exposed to.

We have to understand the risks.

We have to understand the persistence of possible contaminants. Is this something that we can just wait out or is this something that's going to be there as a threat for a really long time?

We have to make sure we can detect the contaminants, a) so we know we've been attacked; b) so we know where we should decontaminate; and c) so, after we contaminate, we can tell if we were successful.

And we have to develop health protection standards or clearance goals, and work as hard as we can to estimate and minimize the decontamination costs, which can be considerable.

Cleaning up after a major biological or a chemical attack, John, can be very expensive once the clearance goals are established, and it can take a long time to meet the goals. So setting the goals will likely not all be up to EPA, and will turn out to be a mix of science and of economics and of politics.

Let's look back for a moment. The response and recovery from the Amerithrax attack -- the anthrax attacks back in 2001. Keep in mind that in this particular case we had an incident, or a group of incidents where a few grams of one bacillus anthracis -- one organism, contaminated 23 public facilities, and the aftermath cost about $1.3 billion -- that's billion with a "b." Now, that translates into a really wide range in individual building costs. We figured it was somewhere between $40 a square foot to clean up a mail-handling facility, and $9,000 per square foot when you think about the Senate Hart Office Building, and that remediation was completed back in 2003. And in that incident I think 22 people became ill; sadly, five people died; and thousands of people required courses of antibiotics.

Now let's take a comparison: As of mid-2006, FEMA, the Federal Emergency Management Agency, which is now part of DHS, it spent only about -- I mean, this is a huge amount of money, but it was about three times as much, about $3.6 billion to remove nearly 100 million cubic yards of debris from the Gulf region that was slammed by Katrina. That's a huge amount of trash. I mean, it's sort of -- somebody calculated that it was five football fields two miles high. But this is a lot of money.

Since that time, what our scientists have been doing is making considerable advances in our ability to recover from contamination. Now, initially most of our work -- and this is understandable since the first attacks were on individual structures, our first research was, how do you recover from contamination in a single structure, in a single building? But now we're focusing on how one might approach a much larger scale event, say, an attack on a neighborhood, or a port, or an entire city.

So at the same time as we've been planning our research -- and we've been doing all of this in consultation with the Department of Defense and with our partners and our customers -- we're always on the lookout for ways to make cleanups and recovery more cost-effective. Advances in rapid assay and detection technologies are helping a lot in this area. Although we're still all working on better tools, everybody wants the "Star Trek" Tricoder (sic?). That's the "holy grail," they feel, in this area.

But the fact is there's still a lot we don't know how to do. And in this area, a lot of this brand new, kind of, over-the-horizon technology for this, we really do depend on DOD, and there's a lot of work that's being done with DARPA, the Defense Advanced Research Projects Agency and DTRA, which I mentioned before, and we're really grateful for the collaboration that we have in this area, and we always hope that our scientists are of considerable help to them as well.

But there are still significant knowledge gaps for strengthening our resilience and our preparedness for the wide-area consequence management, which is kind of the next area that we're looking at very seriously.

DR. OHAB: And Dr. Jutro, we talk on this program over and over about translating scientific discovery into practical applications that can impact both the military as well as the general population. How has the EPA's research been used in real-world situations? DR. JUTRO: Well, let me just give you a couple of examples, because I think we should consider ourselves blessedly lucky that we haven't had a very extensive need, or a frequent need to apply our homeland security developments to real-world attack situations.

But our researchers have assisted other federal, state and local emergency responders. We helped determine the scope and the severity of the risks associated with the attack on the World Trade Center on 9/11. We supported the efforts of the locals, and other government agencies to monitor and manage the aftermath of the attack. So we helped set clearance goals for helping residents and workers in the area decide on their own when they might return to their homes and offices and feel comfortable about it. EPA researchers were also called in to ascertain the extent of contamination, and to decontaminate the Senate office building, as in the postal service facilities that were hit with Amerithrax following the spore incidents in 2001 and 2002.

The research we've done on rapid detection and monitoring systems is now helping drinking water systems around the country try to prevent widespread contamination of water supplies. We're currently working on contamination warning and response systems in five American cities, and working closely with the governments of those cities to implement and to test these systems. And we continue to respond to requests for the latest scientific developments on detection and risk assessment and decontamination.

And I guess most recently we've had involvement with a number of incidents that involved anthrax. And those were not malicious incidents, but those were incidents, interestingly, where drummers, and others, including other musicians, were exposed to anthrax spores from inadequately-cured, contaminated hides that are traditionally used to make drums. And what was contaminated were not only the individuals, but the buildings they were in.

So we have a history of continuing to work with others to apply our research, and we certainly -- you know, we'd be delighted if this was the extent of what we were called upon to do.

DR. OHAB: Now, you mentioned some work in the past with the Pentagon Force Protection Agency, the Defense Threat Reduction Agency and the Defense Advanced Research Projects Agency, or DARPA. What types of collaboration are EPA and DOD currently engaged with, with respect to the homeland security research?

DR. JUTRO: Well, there are a few I can talk about without breaking any rules. EPA and DOD are collaborating on a bunch of dual-use tools, and models, and technologies and methods -- things that can be used for homeland security but will have broader, either environmental protection or defense, uses as well. Let's see if we can go through a couple of examples. There are vulnerability assessment tools, risk assessment models that help water suppliers survey their facilities and help them improve physical security. One of these models generates options for improving security of a facility where they're needed.

One that we've been working at with the Corps of Engineers down in Vicksburg is something called the "Blast Vulnerability Assessment Tool," and it tries to figure out what the vulnerability of different facilities might be to threats or attacks with explosives.

And it recommends corrective action or more protective actions; how to implement them; and, having identified the vulnerable areas, where these changes should take place.

We've development models. One of the interesting ones is TEVA. It's our Threat Evaluation and Vulnerability Assessment tool. And in the case of TEVA, what we're looking at is the hydraulic flow of a water system so that we can predict the path that a contaminant might follow if it were introduced. Now, John, you know, I'm sure, that water distribution systems are, really, they're amazingly complex systems, and it's almost -- it is impossible to predict with certainty where a given drop of water will go. I mean, the fact is that if somebody turns on a faucet or flushes a toilet in one part of a city, a drop of water might go somewhere totally different than it would have gone -- and this is miles away, had that one faucet not been turned on.

This makes prediction really a nightmare, and engineers and scientists have realized that it can't be done perfectly. But TEVA can identify places -- it can identify the best locations for placing contaminant warning systems so that we can actually get information that has the highest probability of being useful.

Also, water systems operator(s) use all kinds of instruments to measure water quality on a continuous basis in their systems, and there are instruments that can set off alarms when they detect physical chemical parameters that are outside the normal operating range that might indicate a possible chemical attack or biological attack. But these things are also useful on a day-to-day basis.

Operators can then follow up to determine the cause of the alarm, and then devote some time to verifying the actual capabilities -- we devote a lot of time to verifying the actual capabilities of different technologies. And that becomes a very important function of our center as well, as a lot of people are manufacturing tools that they are trying to sell to the public, or trying to sell to water systems, or to other government agencies, and we all have to make sure that we get good value for our investment and that these devices are capable of accomplishing what we want them to accomplish.

So EPA and DOD work collaboratively on developing what are called "standard analytical methods." This is a close collaboration on laboratory methods for measuring chemical, and biological and related agents that could be used in an attack. If there's an incident in the United States, the number of samples -- as we've learned, that will have to be analyzed is huge.

As I said before, you've got to -- you've got to take samples to figure out what the contamination was. You have to take samples to figure out what area might be contaminated. Then, after the incident, you have to take yet more samples to figure out if you've been successful in the contamination.

What we need is standard methods to be sure that all the testing results are accurate, and are comparable, and that, most importantly, the results don't depend on which, of dozens of different laboratories, a sample may be shipped to is. So this is a critical area -- the standard analytical methods that EPA and DOD work on together.

And decontamination methods have been, and they continue to be, developed that can be used to clean up contaminated buildings, and city streets, air conditioning systems, transportation systems, water distribution pipes. And we have to be sure that, during the decontamination, the left over contaminated water or other material can be treated and disposed of safely.

And a final example -- it's an interesting one, we maintain a model water system in one of our labs. It's a series of pipe-loops -- isolated pipe-loops at our laboratory in Cincinnati that we can put things into and do testing in. But there are some things we can't put in there, so we worked with the Army to develop similar physical capabilities, similar pipe loops to allow us to work on testing chemical warfare agents and other things that really could only be done on a well-protected military facility.

So that's just a small, sort of, selected set of examples of things that we're actually doing together and which we also help one another.

DR. OHAB: I've got a couple of questions left here in the remaining six or seven minutes.

From time to time we break out the old "Armed with Science crystal ball." When you look into that crystal ball, what do you see? What are the plans for EPA in the future, in terms of collaborating with DOD researchers and scientists?

DR. JUTRO: Well, we know that we have to move forward together. And we feel we also have the challenge of meeting this administration's goals for protecting America's communities' drinking water, strengthening the nation's resilience, and making sure we have the ability to recover quickly following any incident or any attack. And we've worked on a whole slew of interagency agreements to make this work. I think I mentioned a few moments ago that just recently we've been working with DOD and with

the Department of Homeland Security on an agreement to share information, very extensively and very openly, on the research we do to try and make sure that we're not duplicating each other unnecessarily, or not doing more duplication than good science calls for, and also to make sure that all of our needs are being met.

But, homeland security research is kind of a continuous scientific question and we undertake it with universities, and think-tanks, the intelligence agencies, other agencies, and, of course, DOD. And we need to know: What are the threats? How are they changing? What do we know about those threats? What do we know about what's known? How do we think about the unknowns that we may be facing?

Our current problem -- as I think I've said before, is that we know very little about the impact of this possible, wide area of biological, chemical or radiological threat on the ecosystems, on the air, on water quality, on long-term land disposal options, even on climate security. And our research should really help us achieve that broader sustainability goal as well. And sustainability has become a huge driver for all of DOD's and EPA's research and development programs, and we pay particular attention to strengthening the resilience of our communities and their infrastructures, realizing that that can contribute to the long-term sustainability of society in the United States.

DR. OHAB: Well, I know we've covered a lot today. And as we wrap up today's program, is there anything else you'd like to tell our listeners about the EPA's Homeland Security Research program? And also, just to add on to that, would you mind telling us a little bit about your background and how you came to work at EPA's National Homeland Security Research Center?

DR. JUTRO: (Laughs.) Well, those turn out actually to be very different things, but it's an interesting question.

What can I tell you about our Research Center? Well, we have a stunningly competent group of scientists, and engineers and support staff at our center -- the National Homeland Security Research Center. And, interestingly, all of us signed up to a very uncertain professional future back in 2003 because we joined, all voluntarily, what was supposed to be a temporary assignment.

This was a long time ago. This was before DHS was even created. Now it's 2010 and we're still at it. It became clear that this was not a problem that was going away and there was a lot more science that needed to be elucidated, and a lot more research that needed to be done that we hadn't anticipated when our center was created.

On a personal note, I ended up in this, as probably most of my colleagues did, mostly by accident. My background was heavily in risk assessment. I had done a lot of work in biology and epidemiology. I had moved into climate change, and I was very interested in the use of satellites for observing climate change. This tied me into the intelligence community and the use of some of the remote sensing tools that they had.

And my exposure to the intelligence community led me into the fact that climate change was not the only disruptive factor that was facing society, but terrorism was as well. And as a result, through a long series of coincidences, I ended up at EPA's Homeland Security Research Center. But EPA is going to be looking more broadly in the future at an all-hazards approach to try and figure out how to address our research program mission. You know, when you think about it, the cause really doesn't matter for EPA. We have to deal with the aftermath. We don't care if it's an "act of god" or whether it's the work of a terrorist, from an operational point of view. Whether it's Osama bin Laden or Hurricane Katrina, our job is to do the results -- to deal with the results, and to try and clean things up, and help everybody else bring society back to a sense of normalcy.

So we need to glean what we can from the science and the research that's gone into responding to natural disasters -- like volcanoes, or earthquakes, or floods, or tornados, climate change, to see what we can learn about responding to and recovering from homeland security threats.

And we work very closely with our DOD colleagues, and with those in other agencies, and outside government in order to meet these national security goals. And even our natural (disaster) hazard work really is a national security goal. In the end, the lead federal responsibility for protecting drinking water and decontamination may rest with us, but it's part of a much broader picture.

And there are also problems that we're going to be facing. There are huge political concerns about "how clean is adequate" following an attack, in terms of recovering from biological or chemical or radiological threats. What are our technological limitations? What are the health impacts of exposures?

What about the environmental justice components; the amount of money; the amount of time that it'll take to deal with some of these problems and achieve our mission? What are the public perceptions of what we do and what their threats are? And to what extent is there political acceptance of what it is we do and the conclusions to which we come?

So we also find that we're moving more into the social science realm, and, for our part at EPA, this is a very interesting transformation. So as we move forward, we see a lot of opportunity, a lot of unanswered questions, and it rests upon the excellent work that's already been done by a large number of really remarkable scientists and engineers in collaboration with their colleagues from elsewhere. DR. OHAB: Dr. Peter Jutro, the deputy director for science and policy at the U.S. Environmental Protection Agency's National Homeland Security Research Center.

Dr. Jutro, thank you so much for taking the time to be here today. Really do appreciate it.

DR. JUTRO: John, it's been an absolute pleasure. Thank you very much.

DR. OHAB: To our listeners, please tune in next Wednesday, April 14th, which happens to be World Malaria Day. We'll be joined by Colonel Chris Ockenhouse at the Walter Reed Army Institute of Research. Colonel Ockenhouse directs the institute's malaria vaccine development efforts.

Thank you again for listening to today's program. I am Dr. John Ohab, and you have been scienced.

END.